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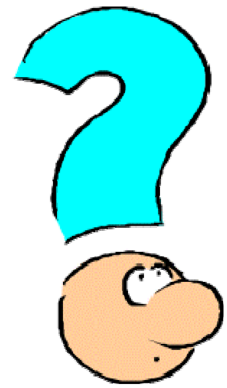

Dry Screening – In A Nutshell

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1. Screening process has been the workhorse for solid-solid separation in chemical, mineral processing, coal and agricultural sectors. They serve many purposes, for example scalping, separation of fines & coarse, dewatering, de-sliming and trash removal. The evolution of various concepts and designs is largely a result of application experience, ever expanding requirements of industry and the creativity of various manufacturers. Even today, most of the expertise on screening resides with the manufacturers.

2. There are two fundamental mechanisms underlying dry screening, namely

   a. Stratification of particle bed caused by the motion of the screener. Bed motion renews the layer of material exposed to the screen. It is also responsible for migrating smaller particles closer to the screen. Our classic understanding of segregation of particle mixtures is applicable here.

   b. Passage of particles through the screen aperture. This is a probability event dictated by competing processes that help and hinder the passage of particles.

3. The throughput (capacity), efficiency of separation and sharpness of cut depend on numerous factors. The complexity of interactions between them makes theoretical modeling of screening operation very challenging.

   Product Related: Particle size, shape, size and shape distribution, specific gravity, bulk density, moisture, coefficient of friction, internal angle of friction, cohesion, coefficient of restitution, abrasiveness, corrosiveness and electrostatic charging tendency.

   Hardware Related: Type of screen (wire cloth, perforated plate, bars, rods), weave or screen design, screen shape (flat or cylindrical), thickness of screen, motion of screen, dimension of screen, number of decks, size and shape of apertures, shape and size distribution of apertures (uniformity of mesh size), agitation blades and blinding prevention measures (e.g. brushes, scrapers, bouncing balls, rings, ultrasonic vibration, probability screens).

   Operation Related: Stroke, direction of stroke (as it relates to material flow), frequency, wave shape of vibration, angle of screener, depth of material on bed, velocity of material on the screener, residence time, wet or drying screening and method of feeding.

   It is evident that screener selection is a much more complex problem than simply specifying various cut sizes.

4. A survey of screening machines is shown in Figure 1. A wide range of concepts and mechanisms are championed by various manufacturers. For new applications, pilot scale testing is highly recommended.

5. Particles of all sizes (d_p) get an opportunity for passage through apertures (w) on a screen. The size fraction significantly smaller than aperture size (d_p<0.8w) readily passes through the screen whereas larger fraction (d_p>1.2w) is retained on the screen as the oversize. The fraction in-between the two limits can be considered “near mesh size.” This fraction is responsible for screen blinding thereby reducing screener efficiency.

6. Screen blinding is caused by near-mesh particles that are stuck in the opening and can not be dislodged by normal motion of the screen surface. This results in reduction of capacity and loss of separation efficiency. A number of measures are available to address the screen blinding problem.

   a. Mechanical: Bouncing balls or hollow cylinders, brushes, scrapers, ultrasonic vibrations on screen and anti-static measures.

   b. Fluid Motive: Air jets and co-current flow.

   c. Probability screens: Prescreening the material with a slightly larger screen opening to remove near mesh size particles and reduce solids loading.

   Care should be taken in the handling of the screens and dislodging obstructions. Rough treatment of screens can affect their performance and cause errors in the amount of material retained and passing through the screen.

7. There are a number of screening media available, namely woven wire cloth, perforated plate, rods, bars and profile wire. A wide range of designs are available for each of these options. For instance, woven wire cloth can be obtained in plain weave, twilled weave, plain Dutch, herringbone twill, double-crimp, lock-crimp, intermediate crimp, etc. Similarly, perforated plates are available in square, round, hexagonal and rectangular openings with in-line or staggered configurations. Selection of screen type requires working within the constraints imposed by performance requirement (throughput and sharpness of cut), mechanical and operational reliability, cost (capital and operational) and material properties.

8. The designation of *Mesh Size* in a woven wire cloth without specifying the opening size or the wire gauge is <u>meaningless</u>. Mesh refers to number of openings per lineal inch. The actual size of the aperture and percentage open area depends on the diameter of the wire. It is also important to understand that the aperture size for a given analytical screen (U.S. Standard or Tyler) may differ from that of a square mesh screen cloth with same mesh designation. It depends on the wire diameter used for making the woven wire cloth.

9. The throughput (capacity) of dry mechanical screening operation drops off sharply when the interparticle forces (due to adhesion, cohesion, electrostatic charging) exceed inertial forces. Interparticle forces also prevent stratification of bed causing reduction in flow area due to coating on the screen. In such cases, a fluid motive force (pneumatic or hydraulic) is commonly used. This approach is commonly applied for scalping of fine powders (e.g. plastic powder, flour).

10. Industrial practice of screener selection, sizing, specification and operation is mostly empirical and experiential. Inadequate screener performance results in loss of prime product or poor product quality. New computational tools, such as DEM, have opened up new avenues for modeling and optimization [4]. It is a technology area that is ready for a **fresh** approach.

References

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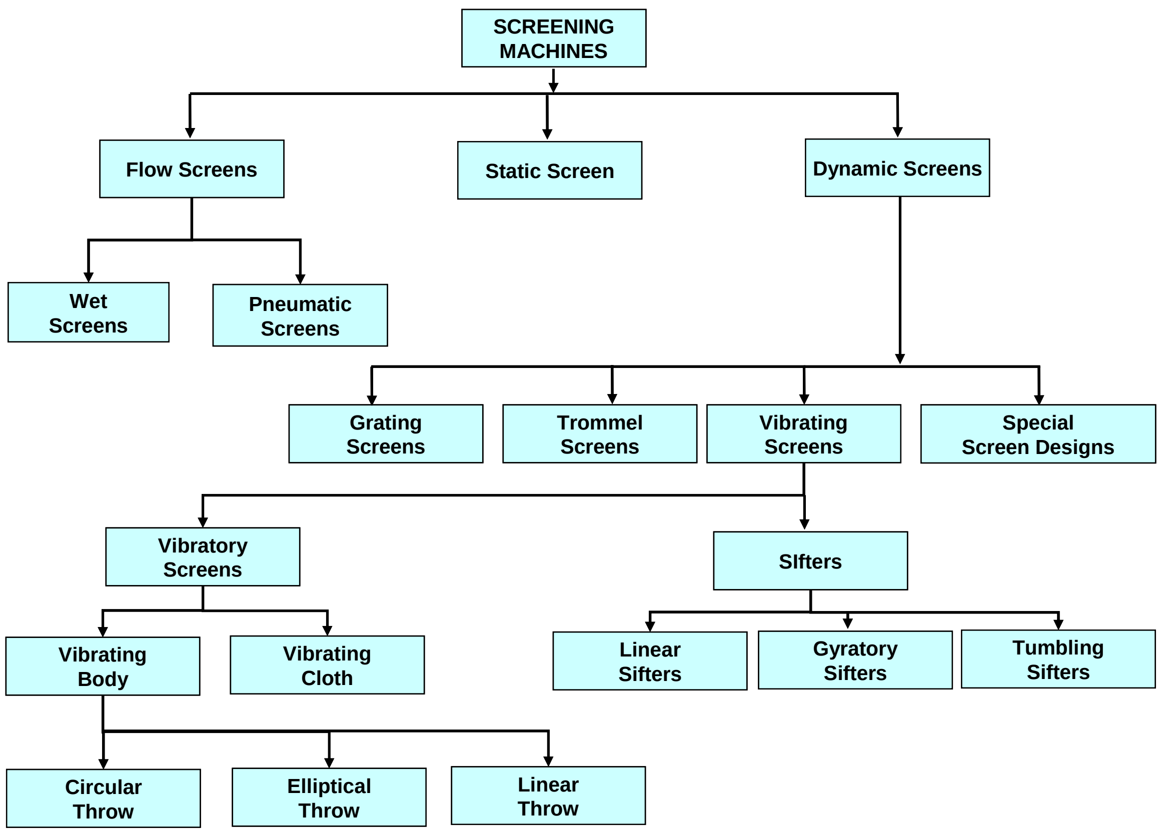

Figure 1. Classification of Screening Machines [1]